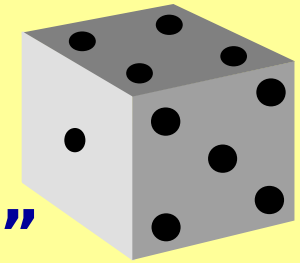
Wright-Patterson Air Force Base Educational Outreach

Hit or Miss!

John C. Sparks

Welcome to “Hit or Miss”

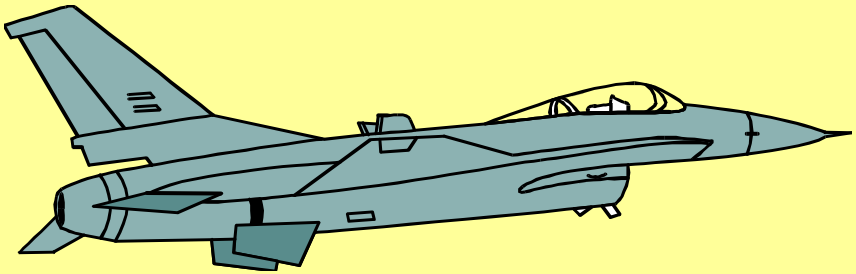
oday we are going to learn:



) Something about chances or “probability”

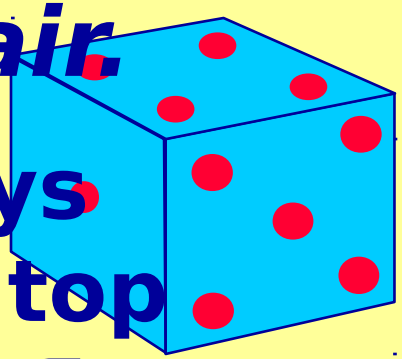
2) Something about experiments

3) Something about how the United States Air Force protects its warplanes



How to Figure Chances and Calculate a "Probability"

Toss a single die into the air.



There are six different ways a number can show up on top when the die lands on the floor.

The number four can show up in only one way

The <u>chances</u> of getting a four are *1 out of 6*

The <u>probability</u> of getting a four is $\frac{1}{6}$ or 1 in 6

Look at the Fraction "One over Six"

- **One is the number of ways the number four can appear on top once the die lands**
  - **Since four is the only number that we want, the number of favorable ways is one.**
- **Six is the total number of ways any number can appear on top once the die lands**

We say the "probability" of getting the number four is one in six

$$\frac{1}{6}$$

1 — Favorable Ways or Ways We Like

6 — Total Ways

Figuring Your Chances and Probability for a Coin Toss

Toss a single coin into the air

**There are two different si
which can show up on top
when it lands on the floor.**

1) Heads can show up in only one way

) The <u>chances</u> of getting heads are *1 out of 2*

) The probability of getting heads is $\frac{1}{2}$ or 1 in 2

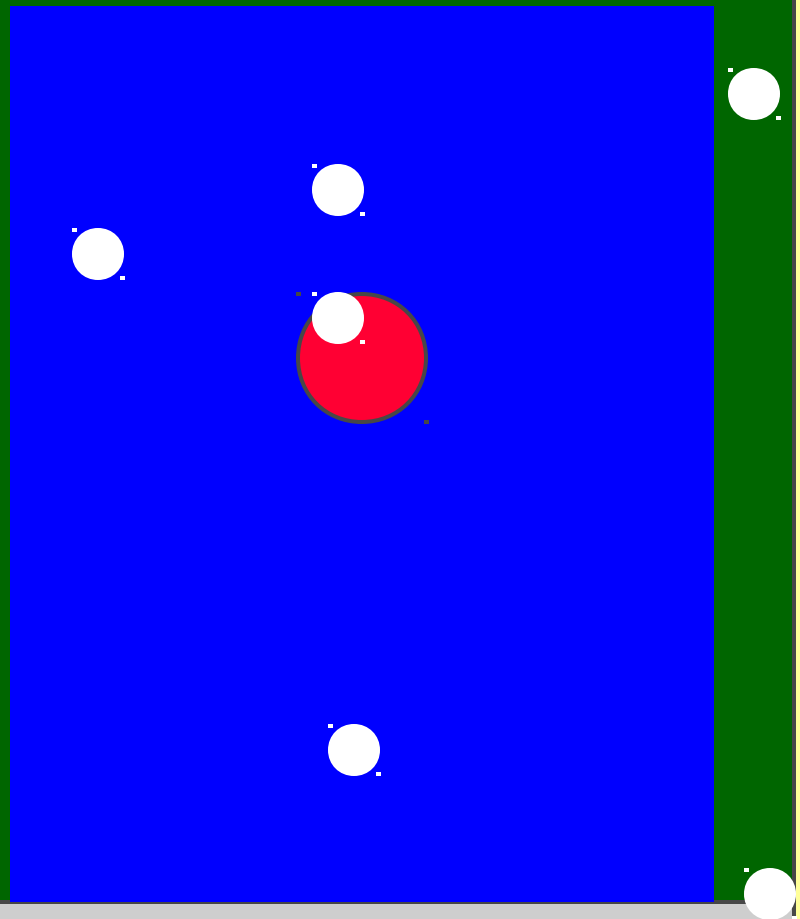
This is the Target Board for the Game “Hit or Miss”

How to keep count

- A blue stick is a hit!
- A red stick is a kill!
- Anything else is a miss!

One more rule

- A kill is also a hit!

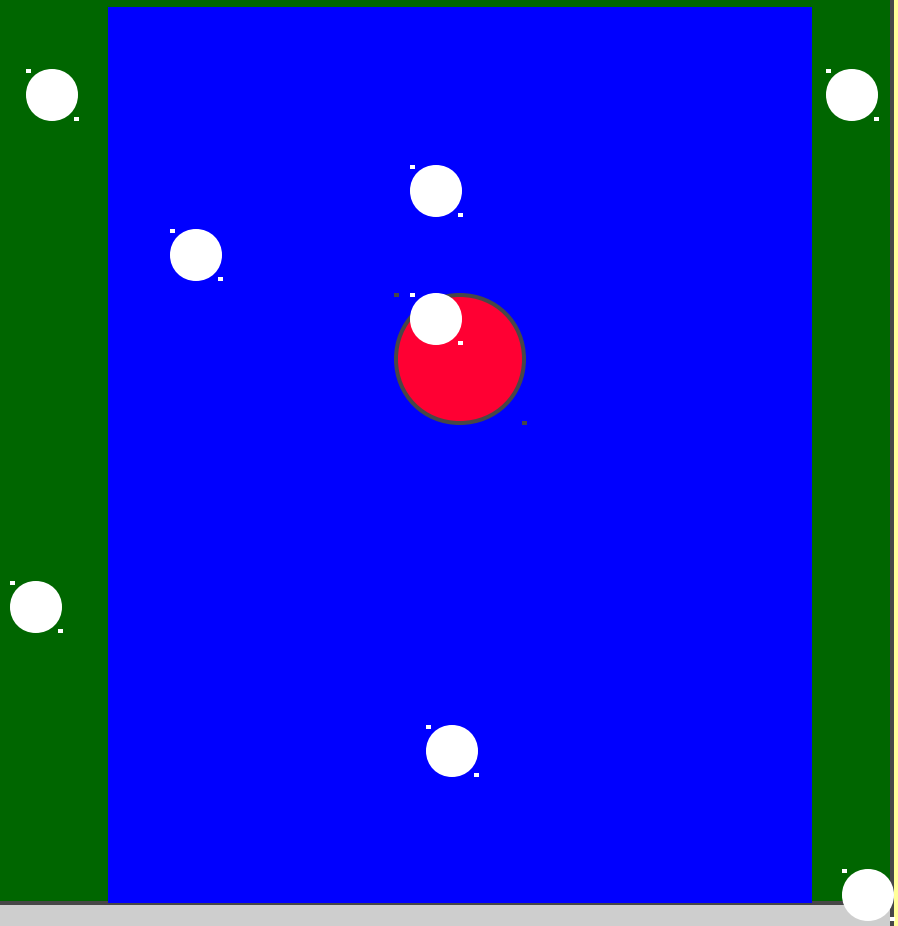


How to Count the Eight Throws Below

Here, 8 throws are made

- 4 are misses
- 4 are hits
- 1 is a kill

The one kill is also a hit



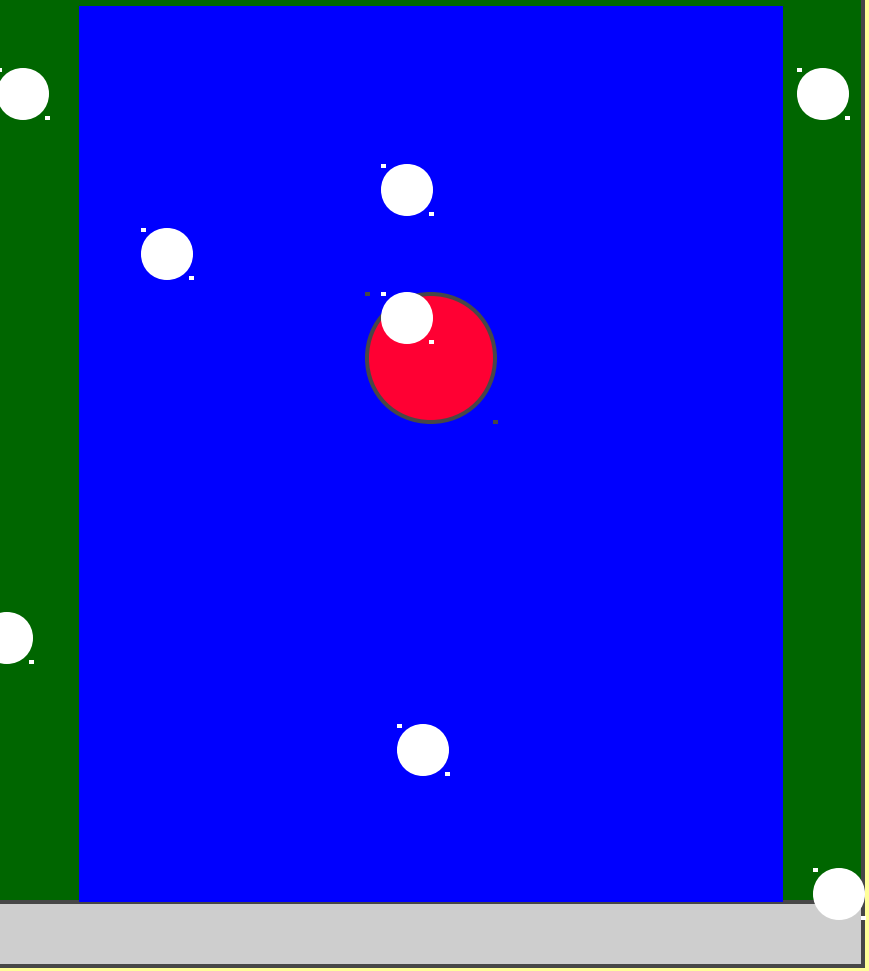
Figuring the Chances for a Hit and a Kill

The chance of a hit is 4 out of 8

$$\frac{4}{8}$$

The chance of a kill is 1 out of 8

$$\frac{1}{8}$$



Using the "Scientific Method" When Doing Experiments

he scientific method has four steps and one ru

State what you want to learn by doing the experiment

2) Make a guess--hypothesis--on what you think will happen when you do the experiment. Give some reasons why you think it will happen.

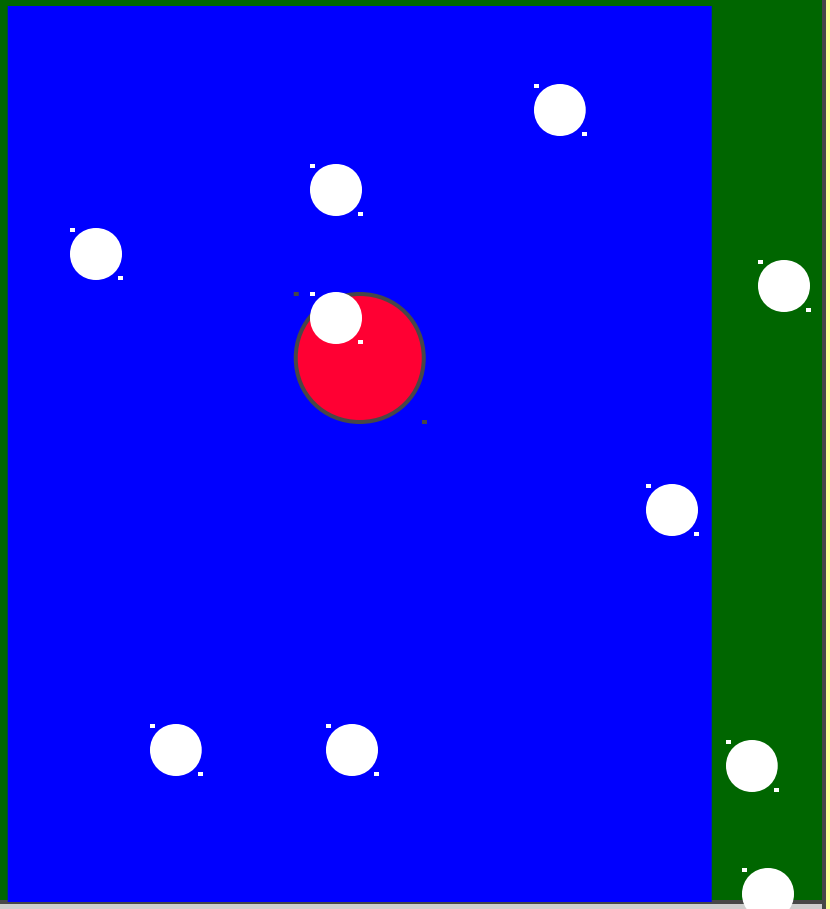
Do the experiment and observe what actually happen

4) Describe the results. Was your guess (hypothesis) correct? Why or why not?

Rule: If you do the experiment more than once, change only one thing at a time.

Today, We are Going to do Six “Hit or Miss” Experiments

We want to do these experiments in order to figure out our chances of getting a hit, and, our chances of getting a kill.



Our First Experiment is Called a “Control” Experiment

My Four Conditions

1) 9 Feet Away

2) Blindfolded or “Blind Guns”

3) No Countermeasures

4) No Armor

We Want to Learn Abou

_____

My Hypothesis or Guess

_____

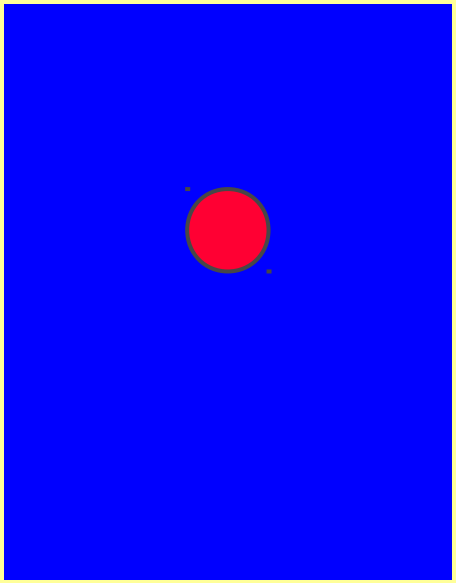
Why?_____

Total Throws or Chances	**Total Hits**	**Total Kills**

The control experiment gives us results to compare against when we start changing things.

More on Making a Guess or “The Hypothesis”

Now that we have done our control experiment, we are ready to do more experiments. Before we do each experiment, we are going to make a guess on what will happen and why. In each hit or miss experiment, we are going to guess if our chances of getting a hit will go up or down, and, if our chances of getting a kill will go up or down.



Second Experiment: No Blindfold at 9 Feet

My Four Conditions

1) 9 Feet Away
2) No Blindfold “Seeing Guns”
3) No Countermeasures
4) No Armor

Name the One Change!

_____

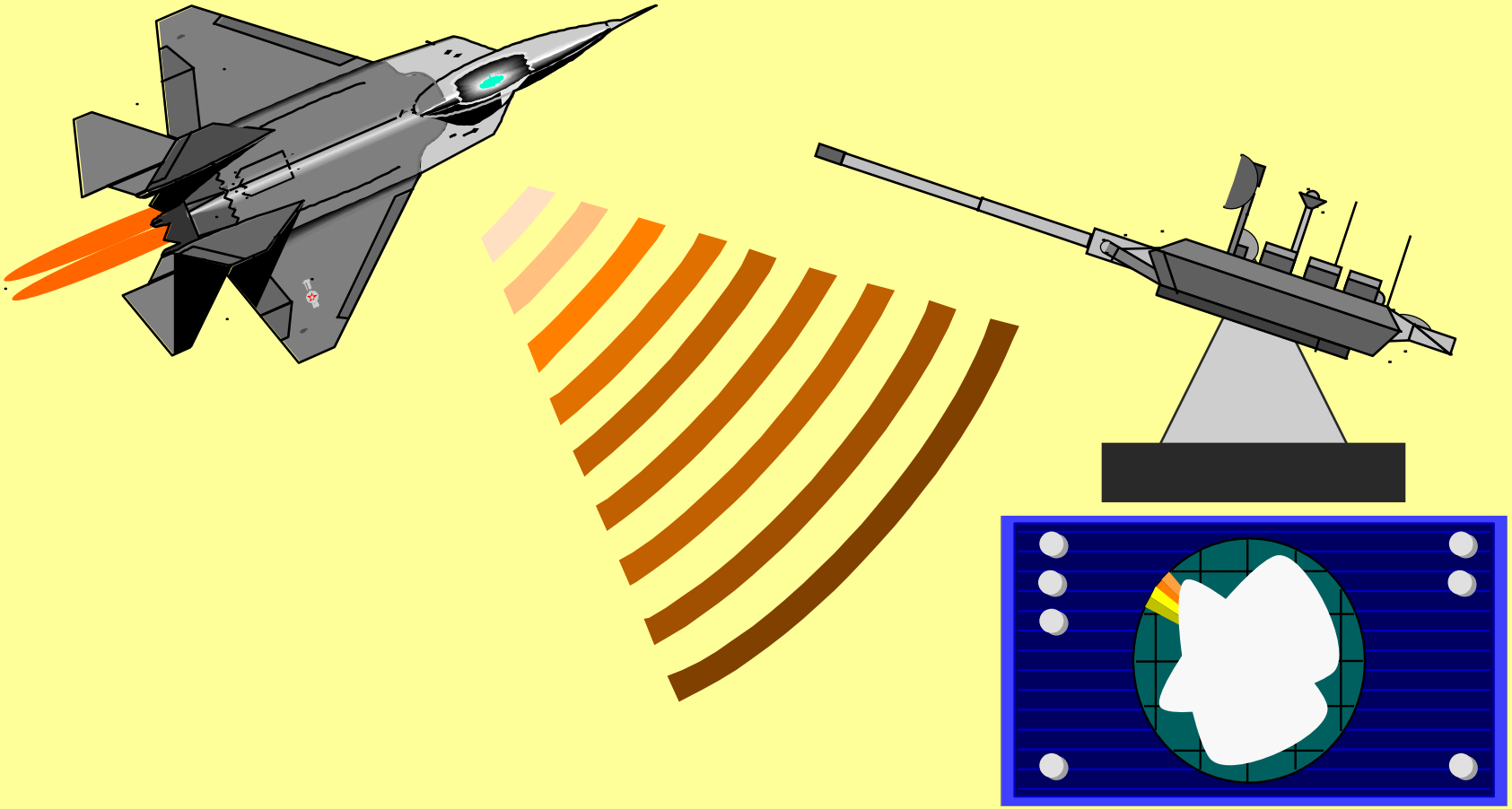
My Hypothesis or Guess

_____

Why?_____

Total Throws or Chances	Total Hits	Total Kills

The USAF Blinds Enemy Guns by Jamming Radar



Third Experiment:
No Blindfold at 15 Feet

My Four Conditions

1) 15 Feet Away
2) No Blindfold “Seeing Guns”
3) No Countermeasures
4) No Armor

Name the One Change!

_____

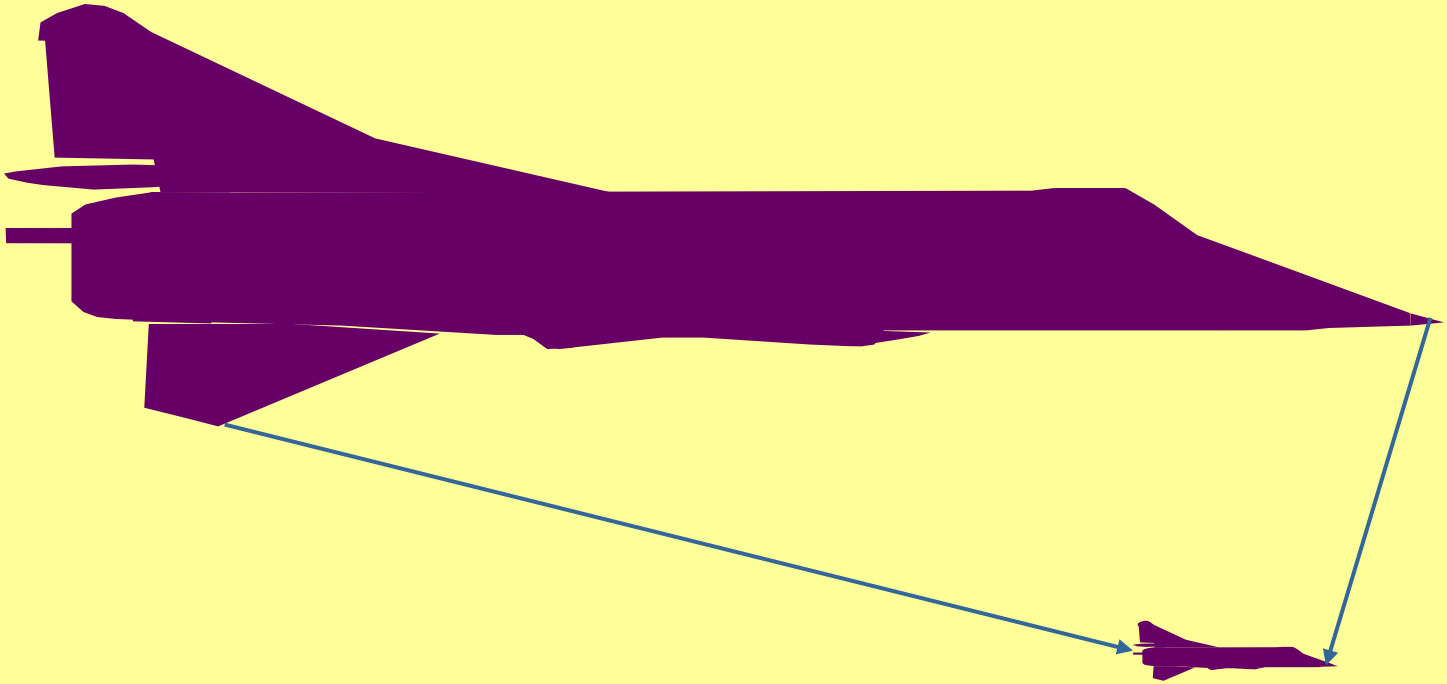
My Hypothesis or Guess

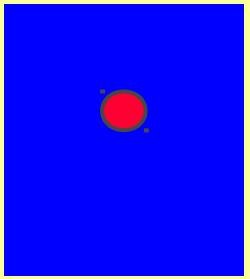
_____

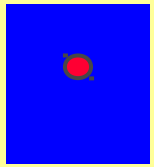
Why?_____

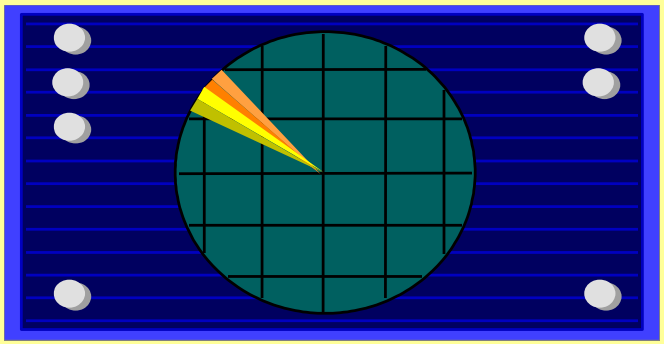
Total Throws or Chances	Total Hits	Total Kills

“Stealth” Technology Makes The Whole Airplane Look Smaller







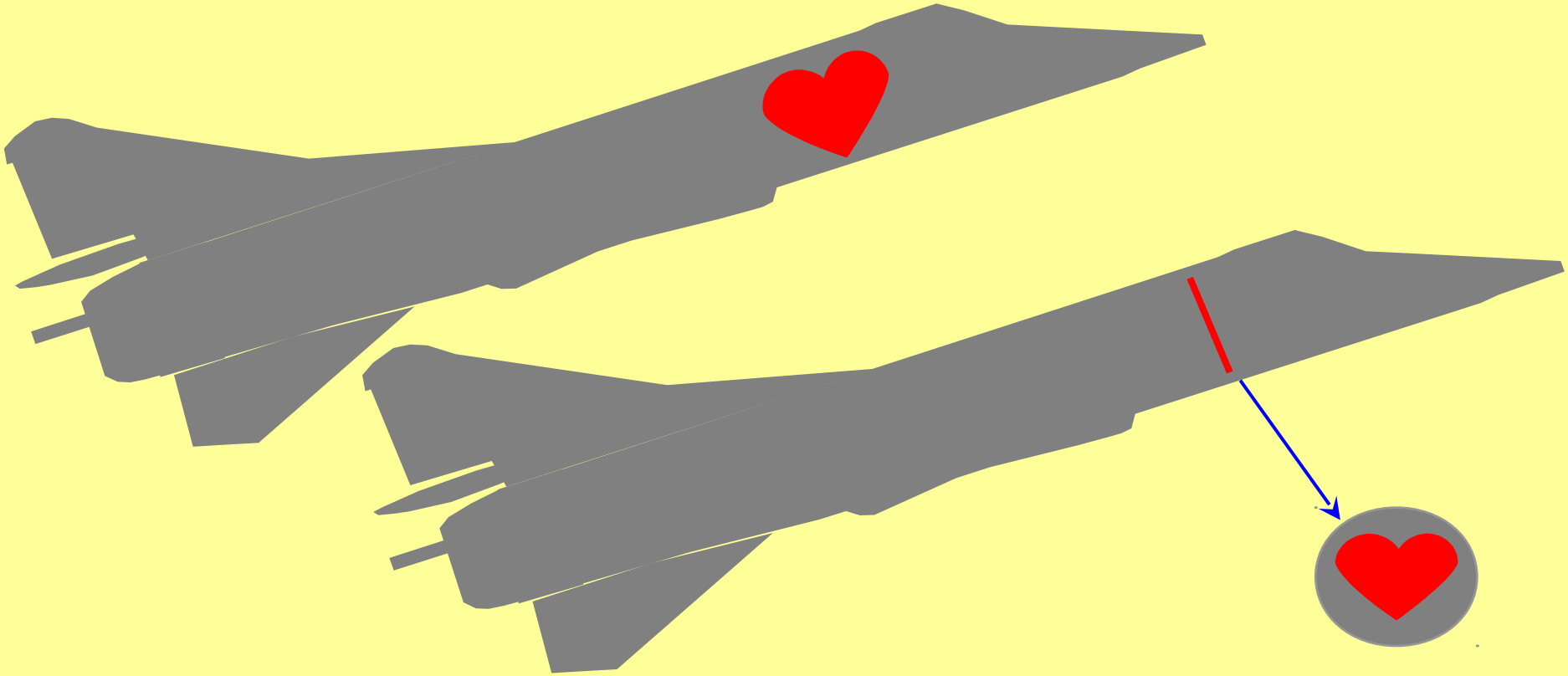


If you can’t see it,
you can’t hit it.

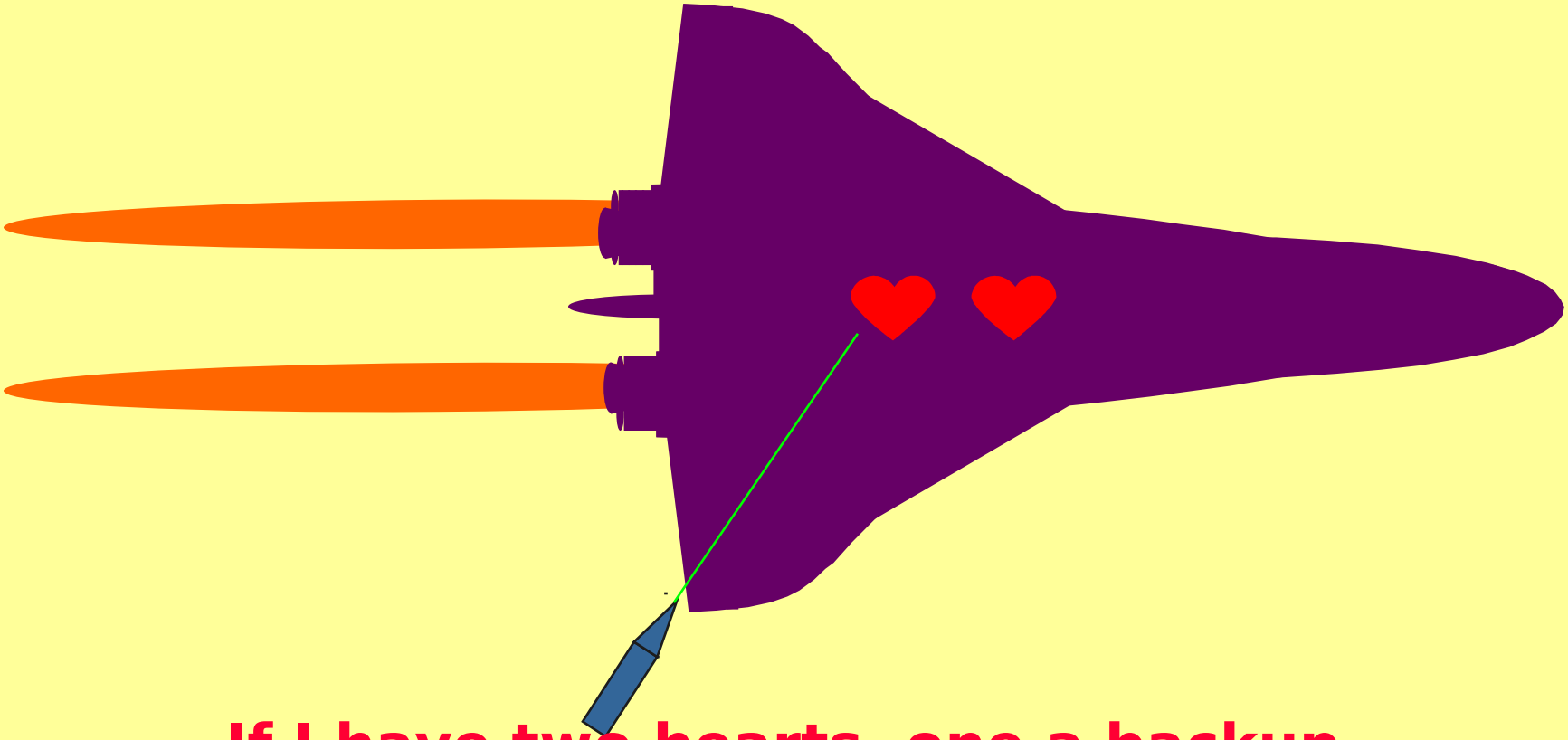
Shrinking the Airplane Heart Only Reduces the Chances for a Kill

An airplane heart is any part of the airplane that when hit makes the airplane crash and die!

Turning the Airplane Heart Sideways Only Reduces the Chances for a Kill



Giving the Airplane Two Hearts Reduces the Chances for a Kill



If I have two hearts, one a backup heart, both have to be hit (two bulls eyes) in order to make the airplane crash and die!

Fourth Experiment: Countermeasures at 15 Feet

My Four Conditions

1) 15 Feet Away
2) No Blindfold "Seeing Guns"
3) Countermeasures
4) No Armor

Name the One Change!

_____

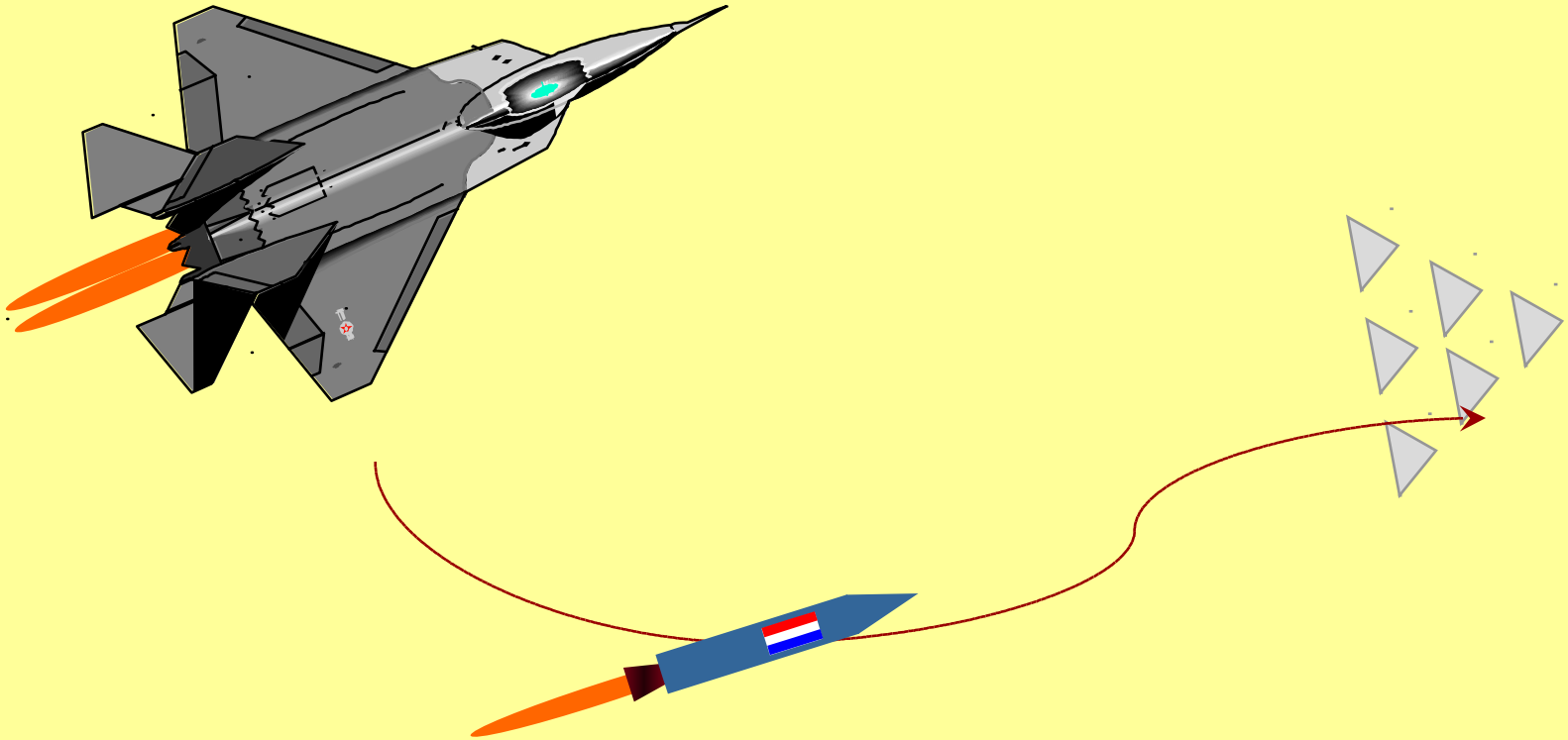
My Hypothesis or Guess

_____

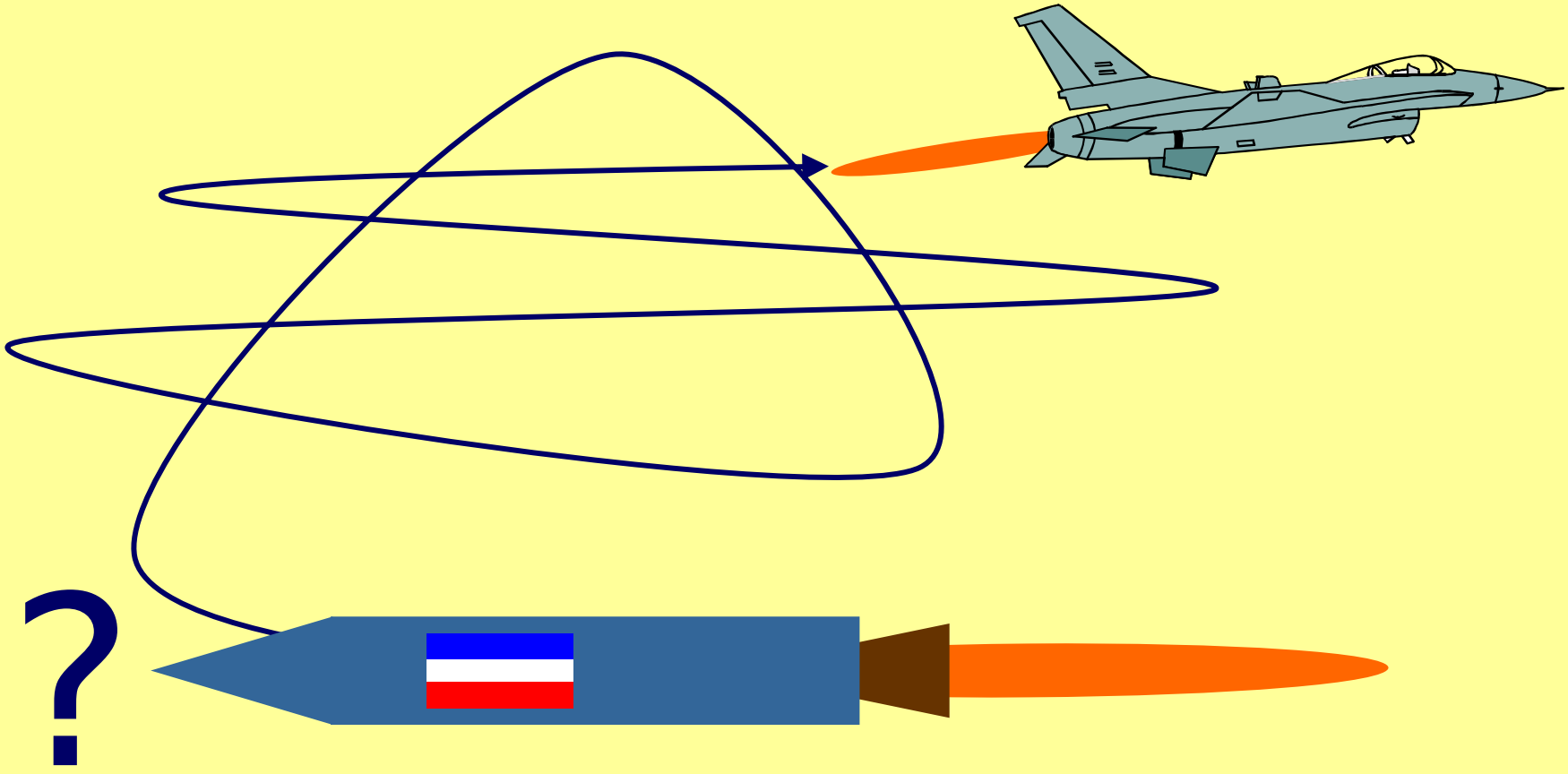
Why?_____

Total Throws or Chances	Total Hits	Total Kills

The Sending Out of Decoys is a USAF Countermeasure



Having High Maneuverability is a USAF Countermeasure



Fifth Experiment: Armor and Countermeasures at 15 Feet

My Four Conditions

1) 15 Feet Away
2) No Blindfold "Seeing Guns"
3) Countermeasures
4) Armor

Name the One Change!

_____

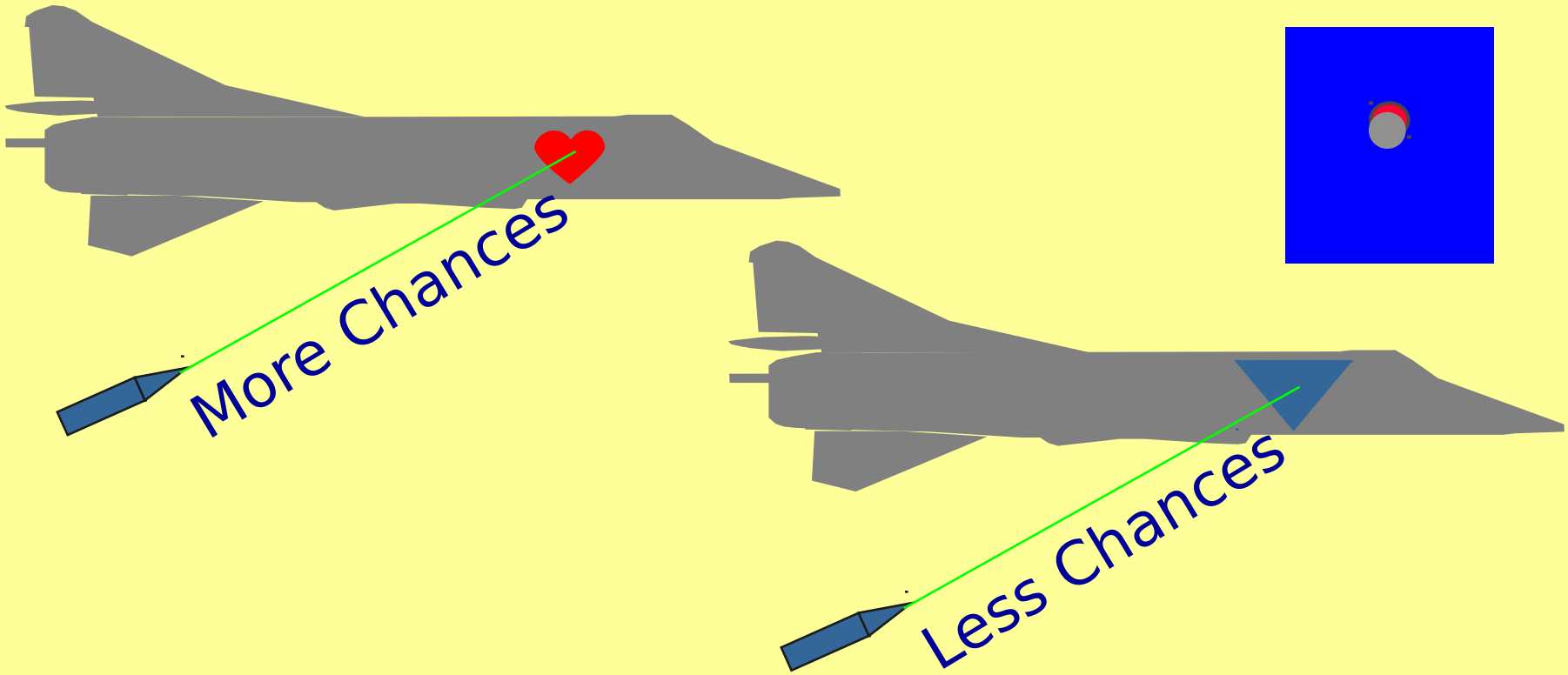
My Hypothesis or Guess

_____

Why?_____

Total Throws or Chances	Total Hits	Total Kills

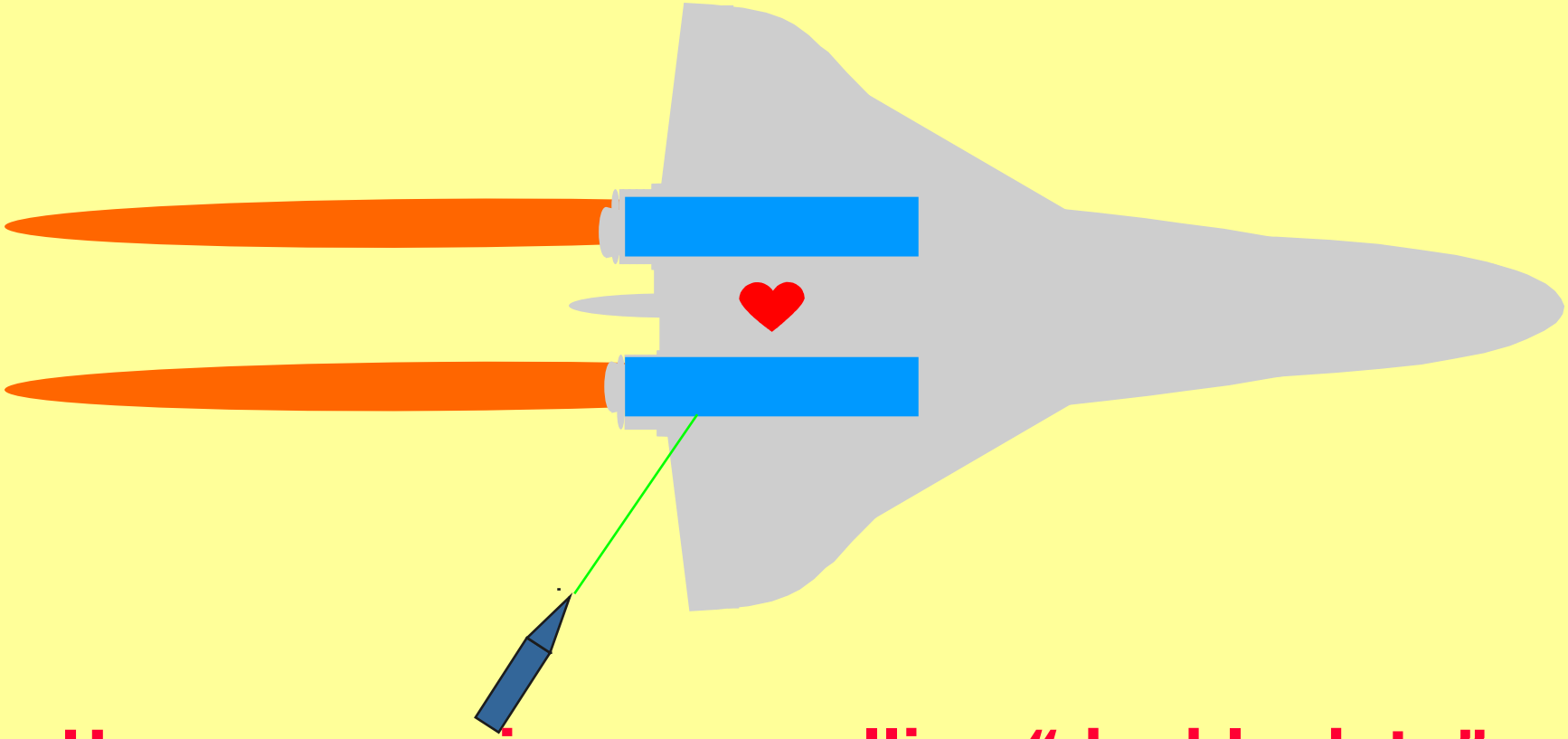
Armor Reduces the Enemy's Chances for a Kill, not a Hit



Armor is placed between the bullets and airplane heart.

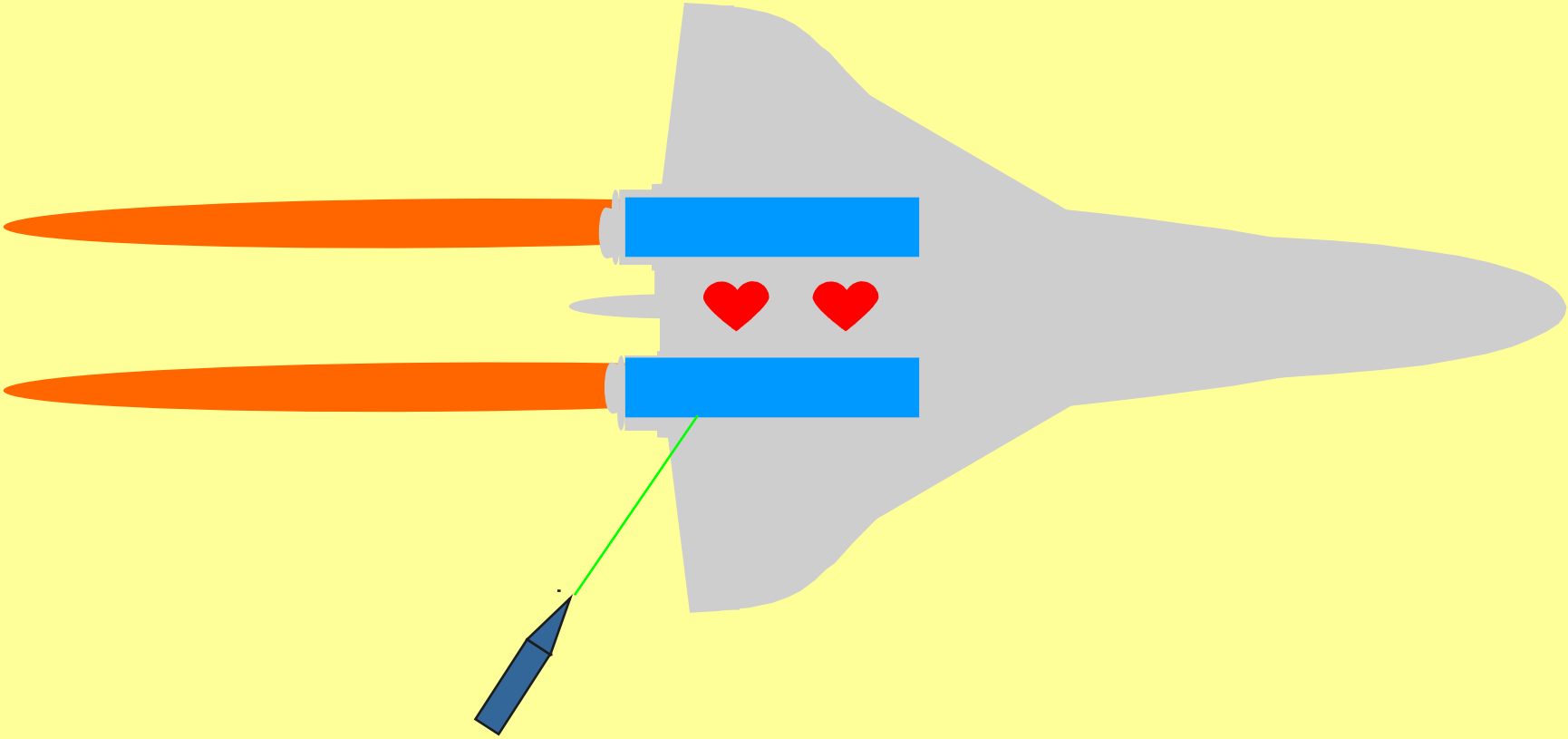
Armor, if used, is only good for bullets up to a certain size.

Using Big Thick Engines as Armor for the Airplane Heart



Here, my engines are pulling “double duty”. They both propel my airplane and serve as armor for the heart.

Here We have Two Hearts, both Protected by “Engine Armor”



Here, two engines are protecting both a heart and its backup heart. Is this airplane hard to kill?

Sixth Experiment: Armor, Blindfold, and Countermeasures at 15 Feet

My Four Conditions

1) 15 Feet Away
2) Blindfolded “Blind Guns”
3) Countermeasures
4) Armor

Name the One Change!

_____

My Hypothesis or Guess

_____

Why?_____

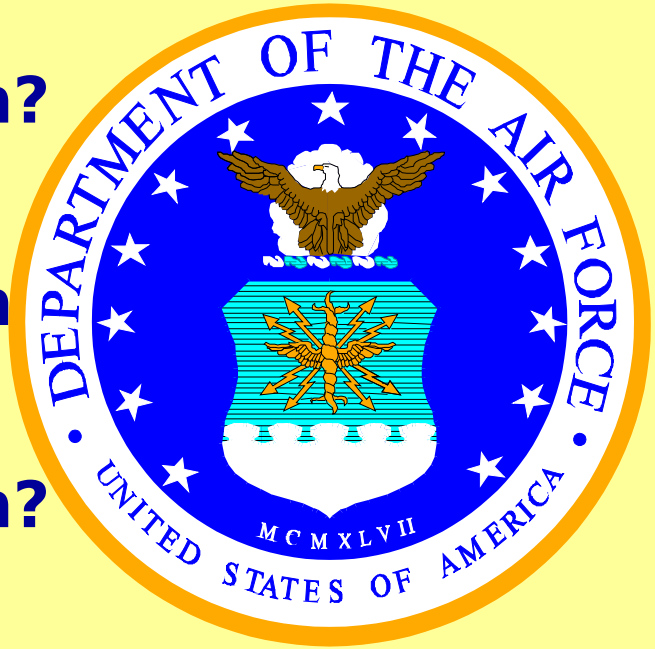
Total Throws or Chances	Total Hits	Total Kills

Summary of Today's Six "Hit or Miss" Experiments

	Change	Total Chances	Hits	Kills	My Two Fractions
1	Baseline				
2					
3					
4					
5					
6					

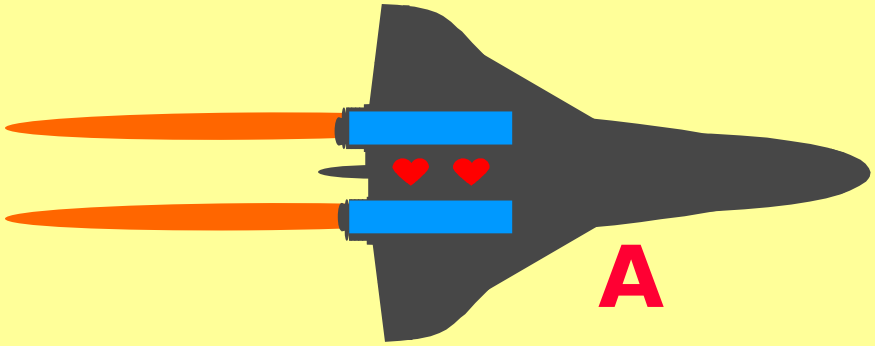
So What did We Learn About Chances From “Hit or Miss”

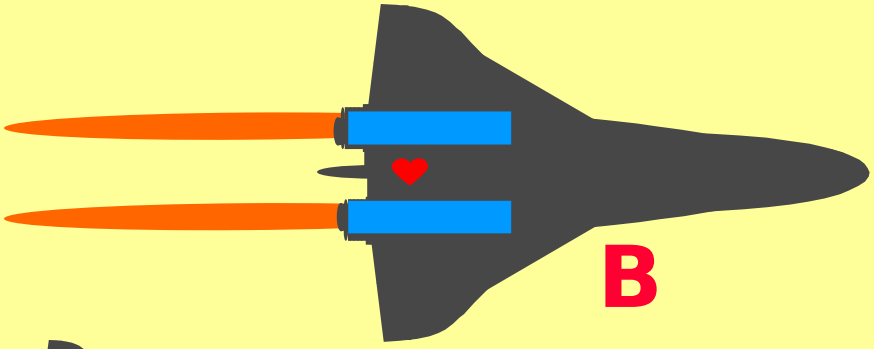
- **Wearing a blindfold**
  - **Do chances go up or down?**
- **Increasing the distance**
  - **Do chances go up or down**
- **Using countermeasures**
  - **Do chances go up or down?**
- **Applying armor**
  - **Do chances go up or down?**

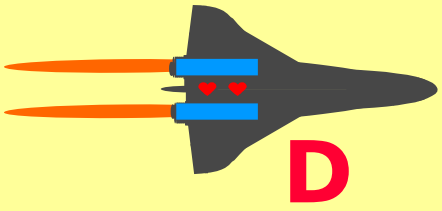


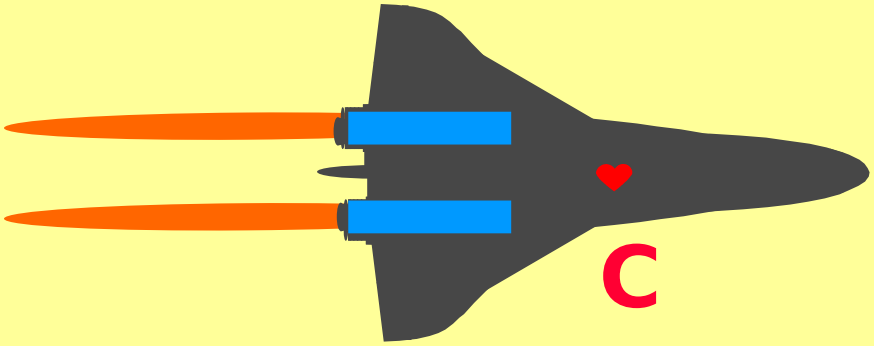
w many of these things do you think the Air Force do

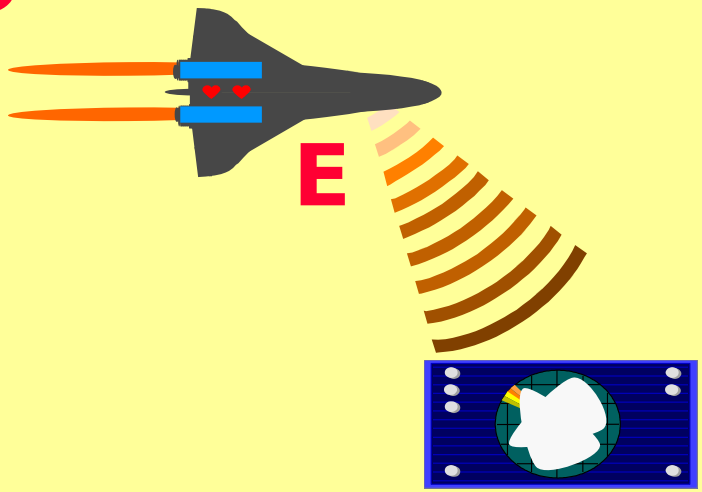
Final Question: Which of the Five Airplanes is Hardest to Kill?







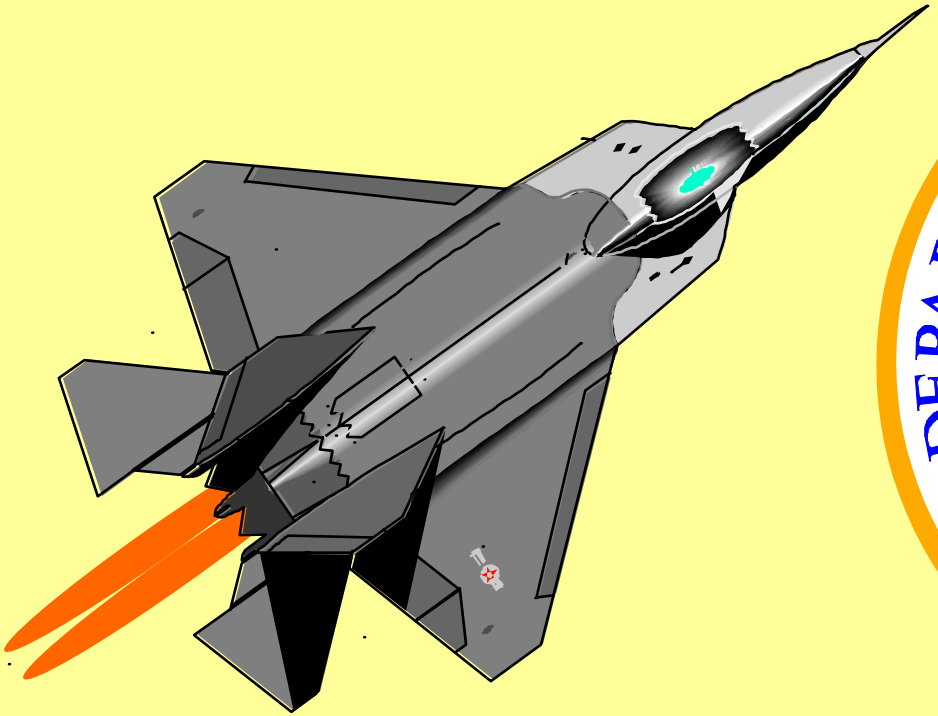




To Summarize

Aircraft survivability is the science of protecting an airplane during peacetime and in war. Aircraft survivability uses experiments to determine the chances for an enemy hit and the chances for an enemy kill. We in the USAF want to make sure that these chances *or probabilities* are very small when we send our pilots off to war!

And the United States Air Force is...



An Expert in this Science!